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The Development of Occlusal Patterns for Orthodontically Treated Extraction Cases

Gerald Tarsitano
Loyola University Chicago

THE DEVELOPMENT OF OCCLUSAL PATTERNS FOR ORTHODONTICALLY TREATED EXTRACTION CASES

by

Gerald A. Tarsitano, D.D.S.

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To my co-investigator and good friend Dr. Charles Bohl, who I feel fortunate in having met and who has helped me tremendously in accomplishing my objective.

VITA

The author, Gerald Albert Tarsitano, D.D.S., was born in Chicago, Illinois. After graduation from St. Ignatius College Preparatory High School in 1955, he enrolled in Loyola University's pre-dental program.

In 1958 he began his formal dental education at the Chicago College of Dental Surgery, Loyola University in Chicago, Illinois.

Upon graduation, he entered the United States Army Dental Corps, serving two years at Fort Ord, California.

In 1964 he began a private general practice in Park Ridge, Illinois which he maintained until 1974, when he began his graduate studies in Oral Biology in the Orthodontic Department at Loyola University in Maywood, Illinois.

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CHAPTER I

INTRODUCTION

"The chaste and delicate mouth is perhaps one of the first recommendations to be met with in the common intercourse of life," wrote Joseph Murphy in 1811. He observed the arrangement of the teeth had considerable influence in giving form and expression to the human face.

As to proper arrangement, Dr. Calvin Case discussed and had a great deal of respect for normal occlusion, but did not necessarily consider it an ideal to be attained. He maintained the concept that esthetics was primary and occlusion was secondary.

Alton Howard Thompson reported "Occlusion seems a necessity to perfect development, for growth depends largely upon the irritation of use, and the desire to indicate a growing insufficiency of employment in the species."

Finally static occlusal determinants prior to the establishment of Orthodontics as a profession was formulated in 1907 by Edward H. Angle who stated normal occlusion is "The normal relations of the occlusal inclined planes of the teeth when the jaws are closed."

The primary objective in Orthodontic treatment is the attainment of an "ideal occlusion" with improved function and stability from the treated malocclusion. The secondary objective is the improvement and maintainance of esthetics.

In this era of "occlusion consciousness," it is also the responsibility of Orthodontics to study cases after treatment in order to determine the post treatment occlusion patterns that have been attained.

To this end, it is the purpose of this investigation to study post treatment occlusions both statically and dynamically and to compare them with those of non-orthodontically treated "normals." All the subjects in this study will have had a Class I or Class II malocclusion, with ANB differences ranging from 0 to 6 and will have had four first premolar teeth extracted as a part of their treatment. Longitudinal studies usually provide a more scientific approach to clinical therapy. Most orthodontically treated cases are held by some type of retainer, however all the subjects in this study will have completed their retention period for at least a minimum of three months.

CHAPTER II

REVIEW OF RELATED LITERATURE

The word occlude means to close, to shut, or to bring together. The precise definition of occlusion of teeth is elusive. Occlusion is a dynamic concept, not merely a static relationship for all the contacting surfaces of the teeth. There must be movement, function, opening, closing, lateral movements and the ability to use the teeth.

Jackson defines satisfactory occlusion as "that tooth grouping consisting of a balanced proportion of tooth substances to bony development, an efficient excursion of the mandible and a pleasing facial appearance.

Edward Harley Angle introduced his classification of malocclusion in 1899. The mesio-distal relationship of opposing canines to each other and the relation of the mesio-buccal cusp of the maxillary first molar to the mandibular first molar were the basis of his classical description of the optimum arch position.

He went on to describe "Old Glory," a dried skull with a full complement of teeth:

> It will be seen that each dental arch describes a graceful curve, and that all the teeth in these arches are so arranged as to be in

> harmony with their fellows in the same arch, as well as those in the opposite arch. . . .Each tooth helps to maintain every other tooth in these harmonious relations for the cusps interlock and each inclined plane serves to prevent each tooth from sliding out of position.

This definition has been misinterpreted by clinicians to believe that occlusion is a static relationship. Static being defined as the interdigitation of the teeth without the imposition of food.

The first suggestion of a functional analysis to occlusion came in 1908 from experiments by Bennett. He wrote, "the normal position of rest of the mandible is with the teeth slightly separated, but with the lips easily closed." He noted that the condylar movement was primarily rotatory on opening from occlusion to rest position and that there was a translatory movement of the condyle.

Dynamic occlusion is the active functional application of teeth to the purpose which nature intended.

From the late 1920's on, many men wrote of the functional or dynamic occlusion. Frail (1927) described cusp-fossa contacts. Planer of Vienna (1930) wrote the occlusal contacts of the teeth was not enough and the efficiency of the masticatory mechanism and its health depended on a number of fundamental considerations. His discussion included definitions of physiologic and occlusal rest positions of the mandible. Planer further illustrated how the differences in positions can be of considerable diagnostic value.

From this era of fundemental theories to the present, functional occlusion has remained controversial.

Granger (1954) stated the continuous contact of the cusps of the teeth do not dictate the movement of the mandible. He firmly believed the temporomandibular joint was more influential in dynamic occlusion than the cusps of teeth.

Schyler (1947) listed five principles of occlusion which encompassed his philosophy:

1. A static coordinated occlusal contact of the maximum number of teeth when the mandible is in centric relation.
2. An anterior guidance that is in harmony with function in lateral eccentric positions on the working side.
3. Disclusion by the anterior guidance of all posterior teeth in protrusion.
4. Disclusion of all non-working side inclines in lateral excursions.
5. Group function of the working side inclines in lateral excursions.

D'Amico (1958) wrote the balanced occlusion theory is incorrect for it is based on three historic geometric observations and does not

apply to man's teeth. He is the chief advocate of the "cuspid rise" theory. He believed the canines to be the "shock absorbers" in occlusion. His theroem is stated in the following three points:

1. Canines guide closure of the jaw into centric occlusion position.
2. In lateral and protrusive strokes, canines contact so as to open the vertical dimension or disengage the posterior occlusion, which prevents contact of cusps of the opposing molars and premolars.
3. Disengagement of the posterior occlusion by the canines decrease horizontal forces.

In summary D'Amico stated the canine teeth act as the guide teeth in eccentric excursions of the mandible.

Stallard and Stuart (1961) defined yet another theory of occlusion which they have termed "mutual protection." They claim occluded natural dentitions have features that differ from bilateral balanced occlusions. They observed fourteen points in studying natural dentitions:

1. Vertical arrangement of teeth allows freedom in cutting, tearing and chewing food.
2. The incisors may be put to work while the other teeth are idle.

3. The cuspids can tear tough foods with no contact of the other teeth.
4. The chewing teeth may be used on either side while all other teeth are idle.
5. A general closure of teeth occurs only when the jaw is in the middle and most posterior occlusal position.
6. The upper anterior teeth have contact with the lower eight anterior teeth in protrusive incisal test position with all other teeth out of occlusion.
7. Only the cuspids contact in a single lateral deflection of the jaw.
8. Only the upper and lower cuspids and the lateral incisors have closure contacts in the latero-protrusive test position.
9. The molars and the bicuspids have occlusal contacts only in centric occlusion.
10. Unilateral chewing can proceed without interference from the teeth across the dental arches.
11. Each upper lingual cusp is capped by a fossa of its mate in lower arch.
12. Each lower buccal cusp is capped by a fossa of its mate in the upper arch.

13. The upper buccal marginal ridges and lower lingual marginal ridges of the molars and bicuspids have no occlusal contacts anywhere at any time.
14. A definite centric occlusion does not permit sliding and it coincides with centric relation.

From these observations Stallard and Stuart postulated the following theory of occlusion:

1. In a pure protrusive test movement, the cuspid may gently touch the rounded buccal surface of the lower first bicuspid.
2. The upper cuspid should be the only upper tooth to have contact with a lower tooth in the lateral eccentric test positions.
3. Cuspids guard the posterior teeth in lateral movements.
4. Incisors guard the posterior teeth and cuspids in protrusive movements.
5. In latero-protrusive positions, the incisors are protected from lateral excursions by the cuspids.
6. In centric closure, the incisors are protected by the molars and premolars.

Stallard and Stuart claimed, "mutual protection" is natural and cannot be provided in balanced occlusion.

Ramfjord and Ash stated, "in order to have functional comfort, neuromuscular harmony must prevail in the masticatory system." Rather than setting forth a theory they list five points which they believe must exist to have functional comfort.

1. Stable jaw relationship when the teeth make contact in centric relation.
2. Centric occlusion can be slightly in front of centric relation position.
3. An unrestricted glide with maintained occlusal contacts between centric relation and centric occlusion.
4. Complete freedom for smooth gliding contact movements in the various excursions from centric occlusion and centric relation.
5. Occlusal guidance in various excursions should be on the working rather than the balancing side.

They concluded the clinician must always be aware of the individuality of the patient's adaptation.

Beyron (1954) reported on still another theory of functional balanced occlusion. His theory is known as "group function" occlusion. From the basic research done on fifty-six Australian Aborgines he

characterizes his theory with the following five points:

1. Excursive movements should occur without interferences.
2. A bilateral movement pattern is a desirable functional feature. Chewing should be possible with equal ease on the right and left sides.
3. Simultaneous contact on the non-working side has no justification in a natural dentition.
4. An unimpeded excursive movement and simultaneous contact between teeth in the active segment should occur within the functional range close to intercuspal position. Extremely long contact glides are abnormal and undesirable.
5. Accordingly, a guidance on the canines that permits free functional glides but guides the mandible on a steep incline or single tooth contact outside the functional boundary would appear to be advantageous.

PERIODONTAL OCCLUSAL STUDIES

In the review of periodontal literature, occlusion is discussed in great detail.

While Box (1940) defined physiologic occlusion, he seemed to be dealing with static tooth relationships for he did not describe what ideal functional contacts should be.

Glickman (1964) reported from his investigations and experiences, truly balanced occlusion is a rarity in natural dentition. Interestingly he did not clarify by definition "truly balanced occlusion".

In Orban's (1968) test, the editors touched on various concepts of occlusion and concluded the variations occur in the handling of the eccentric movements.

Goldman (1968) was the only author to advocate one concept of occlusion. He stated group function is the type of occlusion one should strive to attain for it distributes force and stress physiologically while creating masticatory efficiency.

ORTHODONTIC CONSIDERATIONS FOR OCCLUSION

In review of the Orthodontic literature:

Thompson (1968) showed the importance of functional harmony but did not describe any movements, nor advocate a concept of occlusion. He referred to physiological functional anatomy and balance of muscle.

Perry (1969) also reported of the importance of functional movements but he also did not elaborate on any specific tooth contacts.

In addition Graber (1972) stated the Class II patient has a more complicated functional path than the Class III patient, but did not standardize any eccentric tooth contacts.

Salzmann voiced similar opinions and observations in his text.

Ricketts (1969) wrote that:

1. In lateral strokes the canine is frequently the only tooth in contact.
2. Both sides of the arches do not contact simultaneously.
3. When the mandible is moved forward the condyles on the eminences and the anterior teeth produce a disarticulation of the posterior teeth.

Roth (1973) dealt with orthodontic treatment goals in terms of Gnathological concepts and stated the following principles:

1. The objectives of ideal occlusion are best served by a mutually protected occlusion.
2. Centric relation occlusion should have three point contact of the opposing centric cusps in their respective fossae and a lighter occlusal slope for the opposing anterior teeth.
3. In straight protrusion the maxillary six anterior teeth should articulate equally and evenly with the

mandibular six anterior teeth and the mandibular first bicuspids, and all other posterior teeth should be discluded.

4. In lateral excursions the maxillary canines should act as guiding inclines to disclude the teeth on the balancing side and to disclude the teeth on the working side after approximately 1/2 mm. of group contact.

Andrews (1975) advocated the type of functional occlusion previously stated by Roth.

TOOTH CONTACTS

A number of studies of tooth contacts have previously been done.

As previously stated Beyron (1954) using cellophane strips .03 mm. thick placed them between the teeth to determine contact during movements of the mandible. He found:

1. Contact between several teeth on the working side was recorded for every subject.
2. No one displayed contact on the balancing side in specified lateral positions.
3. Intimate contact in lateral positions and the large number of teeth involved indicates an anatomically harmonious development of the dentition of the

Australian Aborigines.

4. Occlusal contact in protrusive position involved a varying number of anterior teeth and in some cases also adjacent premolars.

Weinberg (1961) visually studied sixty patients for functional tooth contacts. He concluded:

1. Forty-eight of the sixty subjects were aware that they clenched their teeth or "ground" them.
2. Ninty-eight per cent of the subjects showed signs of tooth to tooth contact in eccentric positions.
3. Eighty-four per cent of the subjects exhibited eccentric wear facets.

From this he concluded:

1. Eccentric contacts do occur.
2. During extended lateral movements, the cuspid on the working side may protect the patients from balancing side contacts. However during normal range, equilibrated lateral contacts are still needed.

Weinberg (1964) again studied tooth contacts except this time he recorded one hundred patients on motion pictures. After a frame by frame analysis he reported:

1. Eighty-one subjects had working side contacts.
2. Of the eighty-one, sixteen had balancing side contacts.
3. There was a wide variance as to contact on the working side. It ranged from cuspid only to all tooth contact.
4. Nineteen had a "canine protected" occlusion.

Weinberg further divided these nineteen into two groups:

Group 1

Biomechanical canine protected occlusion, meaning the occlusion was a product of:

a. balancing defective contacts

b. severe overbite

c. poor buccolingual relationship of posterior teeth.

Group 2

True canine protected occlusion.

Scaife and Holt (1969) visually examined one thousand two hundred basic trainees at random to determine the natural occurance of cuspid guidance during the lateral excursion of the mandible. The sample was made up of:

940 (78.3%) Class I

230 (19.2%) Class II

30 (2.5%) Class III

They found:

1. 940 Class I

a. 684 (57%) had bilateral cuspid protection in lateral positions.

b. 194 (16.3%) had unilateral cuspid protection during lateral excursions of the mandible.

c. 56 (4.7%) had cuspid protection in protrusive.

d. 250 (26.6%) had no evidence of cuspid protection.

2. 230 Class II

a. 154 (67%) showed bilateral cuspid protection in lateral positions.

b. 39 (17%) showed unilateral cuspid protection in lateral positions.

c. 37 (16%) showed no cuspid protection.

3. 30 Class III

a. 4 (13%) showed bilateral cuspid protection in lateral positions.

b. 6 (20%) showed unilateral cuspid protection in lateral positions.

c. 20 (67%) showed no cuspid protection.

From these findings they concluded an overall natural occurrence:

1. Cuspid protection occlusion occurs 57% of the time.
2. Cuspid protection occurs most frequently in patients with a Class II occlusion, less in patients with a Class I occlusion and least in patients with a Class III occlusion.
3. Patients with cuspid protection varied inversely with patients having wear facets.

Ingervall (1972) studied tooth contacts on working and balancing of fifty adults and children. He used alginate wafers and studied lateral movements three millimeters from centric occlusion position. He found:

1. There was no significant difference between adults and children.
2. On the average two contacts were found on the working side.
3. Bilateral one tooth contacts occurred on the working side.

8% in children

14% in adults

4. Unilateral one tooth contacts occurred on the working side.

5. The frequency of balancing side contacts were:

66% in children

64% in adults

6. The frequency of canine protected occlusion was:

18% of the total unilaterally

2% of the total bilaterally

Bohl (1974) studied tooth contacts on one hundred non-orthodontically treated normal Class I occlusions and his study is listed in summary form in Appendix C.

Bohl (1976) again studied tooth contacts on thirty orthodontically treated non-extraction subjects, and this study is also listed in summary form in Appendix B.

From this review it is obvious much controversy still exists in regard to a functional occlusion. Dramatically opposed viewpoints are common. It is quite evident more research is required before any definitive conclusions can be reached to guide the dentist.

CHAPTER III

METHODS AND MATERIALS

This study was conducted on thirty orthodontically treated subjects gathered at random from both private practice and from the orthodontic clinic at Loyola University in Maywood, Illinois. The data from this study was compared to the data of Dr. C. Bohl's 1974 and 1976 study, therefore the methods and materials are similar.

The study was structured so two investigators examined each subject in order to cross check the findings.

The records of the subjects were examined prior to examination to determine if they would fulfill certain requirements, namely:

1. That they had received full orthodontic treatment.
2. That four first premolar teeth had been extracted as part of the treatment.
3. That their beginning ANB difference was in a range of from 0 to 6.
4. That their initial molar malocclusion be either an Angle's Class I or Class II.

After this initial clearence the subjects were contacted and informed of the study. The subjects were further quieried to meet further qualifications:

1. All retentive devices had been discontinued for a minimum of three months.

If their response was positive they were then appointed to be examined to determine if they fulfilled the balance of the requirements:

1. No full coverage or cuspal coverage restorations had been accomplished.
2. Both the canines and the first molar teeth be in Angle's Class I relationship.
3. No crossbites were present or any major relapse had occurred.

After the subject was deemed qualified for the study, a questionnaire consisting of twelve items was taken by the investigator to complete the history form (Figure 1). The history sheet dealt with the health of the patient, pain or clicking of the temporomandibular joint, grinding or equilibration of the teeth, length of treatment time, approval of final results and reaffirmation of the questions asked previously. The thirteenth question dealt with the subject's sketetal type and was either obtained from the subject's chart or determined by the examiner.

HISTORY

NAME _____
AGE _____
SEX _____
OCCUPATION _____

1. Are you presently under the care of a Physician? _____

2. Are you taking any medication at this time? _____

3. Have you experienced pain in or around your jaw? _____

When did pain first start? _____
Does pain occur often? _____
Is pain present now? _____
Does anything increase or decrease the pain? _____
Does pain occur on both sides or just one? _____

4. Do you hear noise when you open and close your jaw? _____
Both sides or just one? _____

5. Do you clench or grind your teeth? _____

6. Have your teeth ever been "ground on" or equilabrated? _____

7. Are you presently wearing retainers? _____

8. What type of retainers did you wear? _____

9. How long have you been out of retention? _____

10. Have any extractions been performed in the course of your Orthodontic therapy? _____

11. How long did your Orthodontic treatment last? _____

12. Are you pleased with your Orthodontic treatment? _____

13. What is the patient's skeletal type? _____

Date _____

Figure 1. History Form

The subject was informed of what contributions they would make in this research project. The investigator demonstrated with his teeth as to the type of movements the subject would be expected to perform. They would basically be:

1. To bite on their back teeth
2. Slide their teeth straight forward over each other
3. To bite on their back teeth again
4. To slide their teeth over each other to the left
5. To bite on their back teeth
6. To slide their teeth over each other to the right

It was explained a strained bite on their back teeth was not desired, but rather a normal tooth in contact bite. When they were asked to move either left, right or forward, enough pressure should be exerted in order to just keep the teeth in contact.

The patient was allowed to practice the movements with some help either visually or manually from the investigator prior to gathering the data. When the subject seemed to have mastered the movements, they were then informed that a thin piece of cellophane would be placed in between their teeth in order to determine which of their teeth contacted each other. The cellophane was placed between their teeth and the movements practiced again.

This method had been previously used by Tryde and her associates, McCollum and Granger to detect tooth contacts. The technique works very well in that if a contact occurs the strip cannot be removed, but if there is no contact the strip can be easily removed.

The plastic strip used is manufactured by Micr-O-Reg[a]. It is 12.7 microns thin, silver in color on one side and black and carbonized on the other. The material is not deformed by moisture, will not mold itself over a tooth, is easy to handle and requires no marking of the teeth (Figure 2). Its one disadvantage is it must be held with forceps which may influence the subject's movements (Figure 3).

The plastic which comes in roll form is cut into one inch long strips, 1/4 to 3/8 inches wide, which is approximately the mesio-distal width of a premolar tooth.

The investigator took the data sheet (Figure 4), and filled in the subject's name and other pertinent information available from the subject's record: pretreatment Angle's canine and molar classification, the type of technical therapy employed in treatment, and the pretreatment ANB difference. From visual exam the following were recorded: post-treatment Angle's canine and molar classification, whether any

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[a]Micr-O-Reg, 40-49, 74th St. Jackson Hts., New York 11373.

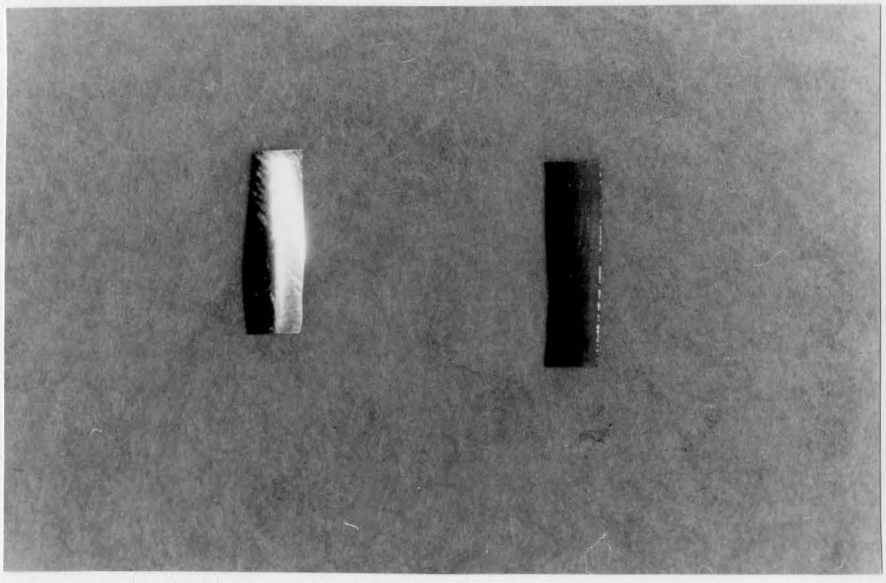

Figure 2. Cellophane Examination Strip

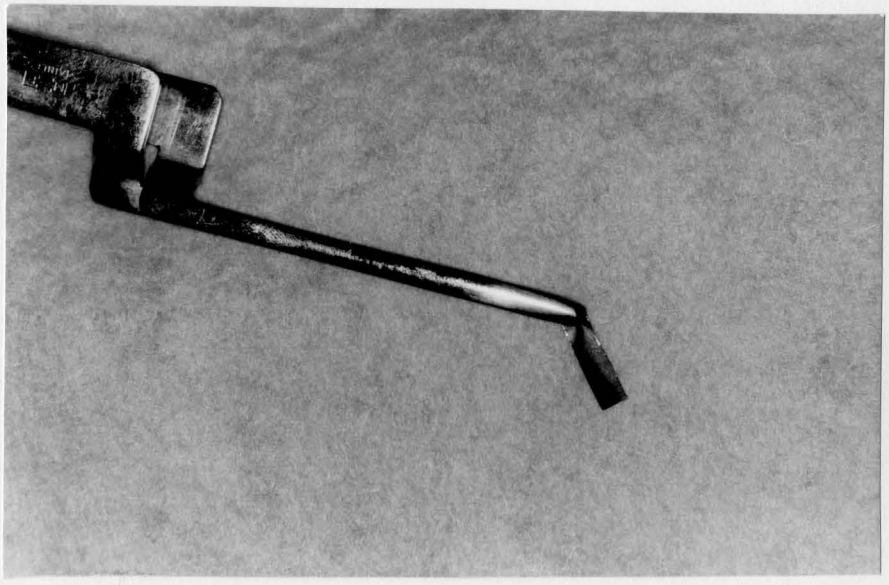

Figure 3. Cellophane Strip In Forceps

NAME _____ EXT ___ NON-EXT ___ | PRETREAT CUSPID R ___ L ___ MOLAR R ___ L ___ | POST CUSPID R ___ L ___ MOLAR R ___ L ___

STATIC ANALYSIS

PROTRUSIVE EDGE TO EDGE		RIGHT LATERAL CUSP-OVER-CUSP		LEFT LATERAL CUSP-OVER-CUSP	
Cuspids Only		Cuspids Only		Cuspids Only	
Cuspids & Other		Cuspids & Other		Cuspids & Other	
Other		Other		Other	

DYNAMIC ANALYSIS

Tooth No.	Resto-ration	C. O.	Prot.	Work	Bal.	Tooth No.	Resto-ration	C. O.	Prot.	Work	Bal.
1						32					
2						31					
3						30					
4						29					
5						28					
6						27					
7						26					
8						25					
9						24					
10						23					
11						22					
12						21					
13						20					
14						19					
15						18					
16						17					

CENTRIC RELATION ANALYSIS

Intercept: Yes / No

Teeth

Slide: Anterior / Right / Left

MECH: EDGEWISE ___ BEGG ___ UNIVERSAL ___

ANB ___

FACETING: YES ___ NO ___

Figure 4. Data Collection Form

faceting had occurred and the charting of the restorations present in all the teeth (Figure 5).

The static analysis was the first investigated for it was the most easily accomplished by the subject and tended to give them a sense of accomplishment, thereby tending to make them more comfortable with the examination. The subject was asked to slide his jaw straight forward and was told to stop when the facial surfaces of the anterior teeth were in the same vertical plane. The investigator visually observed the teeth in contact, if need be he used the strip to verify contact, and marked the appropriate box under the heading "Protrusive Edge to Edge," (Figure 6). The alternatives are:

1. Cuspids Only - The cuspids alone contact and disclude the remaining dentition.
2. Cuspids and Other - The cuspids and some other teeth disclude the remaining dentition.
3. Other - Teeth other than the cuspids contact, discluding the remaining dentition. When this alternative is checked, the teeth contacting are noted on the data sheet.

The subject was asked to slide their jaw to the right with their teeth in contact and told to stop when the lower cuspid teeth were in the same vertical plane with the upper cuspid teeth (Figure 7). The

Figure 5. Centric Occlusion - Frontal

Figure 5a. Angle Class I Relation - Left Side

Figure 5b. Angle Class I Relation - Right Side

Figure 6. Static Edge-To-Edge Protrusive Position With "Other" Designation

Figure 7. Static Right Lateral Cusp-Over-Cusp Position With "Cuspids and Other" Designation

subject was examined visually and the feeler strip used if needed. The results were marked in the appropriate box under the heading "Right Lateral Cusp Over Cusp." The alternatives are:

1. Cuspids Only - The cuspids alone are in contact discluding the remaining dentition.
2. Cuspids and Other - The cuspids plus other teeth contact, discluding the remaining dentition.
3. Other - Teeth other than the cuspids contact, discluding the remaining dentition.

The subject was asked to slide their jaw to the left with their teeth in contact and told to stop when the facial surfaces of the upper and lower cuspid teeth are in the same vertical plane (Figure 8). The patient was examined visually and the feeler strip used if needed. The results were marked in the appropriate box under the heading "Left Lateral Cusp Over Cusp." The alternatives are:

1. Cuspids Only - The cuspids alone are in contact discluding the remaining dentition.
2. Cuspids and Other - The cuspids plus other teeth contact, discluding the remaining dentition.
3. Other - Teeth other than the cuspids contact, discluding the remaining dentition.

Figure 8. Static Left Lateral Cusp-Over-Cusp Position With "Cuspids Only" Designation

This concluded the static analysis part of the examination.

The investigator began the dynamic analysis portion of the examination. Having used the military notation of tooth charting, teeth number 1, 16, 17, 32, the four third molar teeth, were crossed out on the data sheet since they did not enter into the examination. Teeth number 5, 12, 21, 28, the four premolar teeth, were crossed out on the data sheet for they had previously been extracted and therefore did not enter into the examination.

A piece of cellophane was placed in a pair of locking forceps. The subject was told the cellophane will now be placed in between their teeth to determine which of the teeth contact. After placing the cellophane strip on the distal portion of the occlusal surface of the upper right second molar tooth, the subject was instructed to close "on his back teeth" into centric occlusion. A gentle tug was exerted on the forceps to determine if contact had occurred, (Figure 9). Since the molar teeth are wider mesio-distally than the strip, the distal portion was checked independently of the mesial portion and vise-versa. However, if contact or the lack of contact occurred in either portion it was recorded singularly.

The resultant conclusion, either a + for contact or a - for lack of contact, was recorded opposite the tooth number under the section labeled "Dynamic Analysis, C. O." (centric occlusion).

Figure 9. Dynamic Analysis Centric Occlusion
Right Side

Figure 9a. Dynamic Analysis Centric Occlusion
Left Side

The same procedure was carried out throughout the entire mouth testing each tooth individually and recording the appropriate result opposite that tooth number.

Upon completion of the centric occlusion portion of the dynamic analysis the subject was asked to more their jaw forward with their teeth lightly in contact. The subject was told to continue to move his jaw slowly forward with the teeth in contact until the lower anterior teeth moved beyond the upper anterior teeth. Care was taken so the subject made his movement straight forward. Though the subject was moving beyond a facial vertical plane of the anterior teeth, registrations were only recorded to that point.

The cellophane was placed on the distal portion of the occlusal surface of the upper second molar tooth and the subject was asked to bite "on his back teeth" into centric occlusion. He was asked to slowly move his jaw forward with his teeth in contact. As the subject began to move his jaw the cellophane was slowly removed toward the cheek, using a tactile sense to determine contact. The same procedure was followed with the cellophane placed on the mesial portion of the occlusal surface of the second molar tooth. The result was recorded opposite the tooth number and under the section labeled "Dynamic Analysis, Prot." (protrusive).

The identical procedure was performed on all the other teeth in the mouth and the results recorded opposite that tooth number (Figure 10).

Upon completion of the protrusive portion of the dynamic analysis, the subject was asked, starting with his back teeth in contact to move his jaw to the right with his teeth lightly in contact. Great care was taken to make sure that the movement was completely lateral without any anterior displacement. Though the subject was moving his teeth beyond the facial vertical plane of the upper and lower cuspid teeth, registrations were made only to that point. The cellophane was placed at the distal occlusal portion of the upper second molar tooth and the subject was asked to bite "on his back teeth" into centric occlusion. He was asked to move his jaw to the right with his teeth lightly in contact. As movement of the jaw was occurring the cellophane strip was slowly removed toward the cheek using a tactile sense to determine contact. It was repeated for the mesial portion of the second molar tooth and the result recorded under the section labeled "Dynamic Analysis, Work." (working,) (Figure 11).

The same procedure was followed for teeth number 3, 4, 6, 7, 8, 25, 26, 27, 29, 30, 31, and the results recorded (Figure 12).

Using the method just described, and beginning with the upper left second molar, tooth number 15, the subject was instructed to move his jaw to the left and the results recorded for teeth number 14, 13, 11, 10, 9, 18, 19, 20, 22, 23, 24, under the same section.

Figure 10. Dynamic Analysis Protrusive

Figure 10a. Dynamic Analysis Protrusive

Figure 10b. Dynamic Analysis Working - Right Side

Figure 11. Dynamic Analysis Working - Right Side

Upon completion of the work (working) portion of the dynamic analysis, the subject was instructed to bite "on his back teeth" into centric occlusion and to move his jaw to the left slowly with his teeth in contact. Having the subject open and introducing the cellophane onto the distal portion of the upper right second molar tooth, the subject was asked to close and to move his jaw to the left. When movement began the cellophane was slowly removed toward the cheek using a tectile sense to determine contact. After this procedure was repeated for the mesial portion of the upper right second molar tooth, the results were recorded under the section labeled "Dynamic Analysis, Bal." (balance). The same procedure was followed for teeth numbered 3, 4, 6, 7, 8, 25, 26, 27, 29, 30, 31, and the results recorded (Figure 13).

Using the method just described and beginning with the upper left second molar tooth, number 15, the subject was instructed to move his jaw to the right and the results recorded for teeth numbered 14, 13, 11, 10, 9, 18, 19, 20, 22, 23, 24, under the same section. As with the previous movements, great care was taken to insure that the subject was making a pure lateral movement (Figure 14).

The Dynamic Analysis portion of the clinical examination was considered completed.

The final portion of the examination labeled "Centric Relation Analysis." In order to attain a terminal hinge position, the investigator

Figure 12. Dynamic Analysis Working - Left Side

Figure 12a. Dynamic Analysis Working - Left Side

Figure 13. Dynamic Analysis Balancing - Right Side

Figure 14. Dynamic Analysis Balancing - Left Side

placed his thumb on the facial surfaces of the lower incisors and his four fingers on the chin and the lower border of the mandible of the subject (Figure 15). With the first two fingers of the other hand over the occlusal surfaces of the upper posterior teeth, he manipulated the mandible so as to position it into its most retruded position. Upon closure the fingers were removed from the occlusal surfaces of the upper teeth and at first contact, the subject was instructed to stop closure and to determine where the contact first occurred. Upon full intercuspation the investigator noted whether an intercept had occurred between centric relation and centric occlusion, and as to which direction the slide had occurred. By repeating this procedure several times and by using the cellophane, the investigator was able to note which of the teeth were involved and to the extent if any, and the direction, if any, of the prematurity. The results were recorded under the section labeled "Centric Relation Analysis." The alternatives are:

1. Intercept - yes or no
2. Slide - anterior
   right or left
   combination
3. Teeth involved

The examination by the first investigator was now complete. The second investigator following the same procedure reexamined the

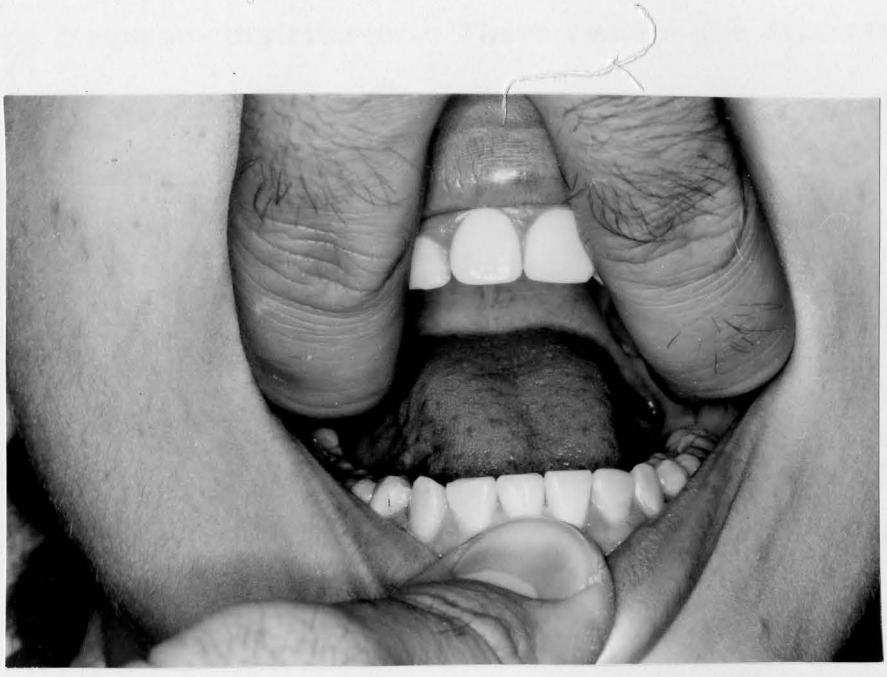

Figure 15. Centric Relation Analysis

subject and recorded his findings in the column next to the first investigator's. If upon completion there was any difference in their observations, both investigators reexamined those areas together and arrived at a singular result.

When the data collection was completed, the information was transcribed on to computer cards, and the computer was programmed to perform a frequency distribution. These results are shown in Tables I and II. The computer was programmed to perform an independent chi square analysis comparing the data gathered from the thirty Orthodontically treated extraction subjects, to the data from the thirty Orthodontically treated non-extraction subjects listed in Appendix B and to the data gathered from the hundred non-Orthodontically treated subjects listed in Appendix C. Three independent chi square analyses were computed, one for the entire dynamic study, another for the individual movements (centric occlusion, protrusive, working and balancing) and the third for the individual teeth in order to determine if any significant differences existed at the .05 level.

CHAPTER IV

RESULTS

Twenty-six of the thirty subjects in the study were female and their mean age was 17.65 years. The four males had a mean age of 17.25 years. Twenty-one had a mesio-cephalic skeletal form, five were doliocephalic and four were brachycephalic.

Twenty-eight of the subjects were treated in the Edgewise therapy of treatment, and two were treated utilizing the Universal therapy of treatment. The mean length of time of active treatment was 32.7 months, and the subjects had been free of retentive devices for an average of 13.63 months. Twenty-three of the subjects had been retained with a standard removable maxillary Hawley retainer and a fixed mandibular retainer from cuspid to cuspid.

The following four Tables contain data collected as part of the dynamic analysis portion of the study. Tables I and II deal with the individual teeth in the various excursions and Tables III and IV deal with the dynamic working contacts analyzed as a quadrant.

In the centric occlusion portion of Tables I and II it should be noted that the posterior teeth have a higher incidence of contact than the

anterior teeth, while in protrusive positions just the opposite is seen. The working analysis contacts show the cuspids to have the highest incidence of contacts, and in the balancing section the second molars are the major contacting teeth.

In Tables III and IV although some posterior teeth have a higher number of occlusal contacts when analyzed as quadrants, the cuspid predominant.

Tables V, VI, VII and VIII deal with the data collected in the static analysis portion of the study. While teeth other than the cuspids are involved in a static protrusive position, the cuspids alone show the highest number of contacts in both the right and left lateral and the bilateral positions.

The following five Tables contain data relating to the dynamic portion of the study. Tables IX and X deal with data relating to the lack of dynamic centric occlusal contacts. It is interesting to note that whether the tooth had no contacts whatsoever or lacked having contact only in centric occlusion, the anterior teeth were most in evidence.

TABLE I

DYNAMIC ANALYSIS - TOTAL NUMBER OF TOOTH CONTACTS IN MAXILLARY ARCH (30 SUBJECTS)

Tooth No.	Centric Occlusion Frequency		Protrusive Frequency		Working Frequency		Balancing Frequency	
	Sub.	Rel. *	Sub.	Rel.	Sub.	Rel.	Sub.	Rel.
2	28	93.3	4	13.3	5	16.7	21	70.0
3	29	96.7	3	10.0	8	26.7	9	30.0
4	19	63.3	1	3.3	7	23.3	2	6.7
5	-		-		-		-	
6	12	40.0	7	23.3	29	96.7	0	0
7	5	16.7	13	43.3	7	23.3	0	0
8	3	10.0	29	96.7	6	20.0	1	3.3
9	3	10.0	25	83.3	5	16.7	0	0
10	4	13.3	12	40.0	7	23.3	0	0
11	15	50.0	4	13.3	29	96.7	0	0
12	-		-		-		-	
13	20	66.7	0	0	8	26.7	1	3.3
14	29	96.7	5	16.7	14	46.7	7	23.3
15	30	100.0	4	13.3	6	20.0	19	63.3

*Sub. = Subject Rel. = Relative percentage

TABLE II

DYNAMIC ANALYSIS - TOTAL NUMBER OF TOOTH CONTACTS IN MANDIBULAR ARCH (30 SUBJECTS)

Tooth No.	Centric Occlusion Frequency		Protrusive Frequency		Working Frequency		Balancing Frequency	
	Sub.	Rel.*	Sub.	Rel.	Sub.	Rel.	Sub.	Rel.
18	30	100.0	6	20.0	6	20.0	18	60.0
19	30	100.0	3	10.0	12	40.0	8	26.7
20	21	70.0	3	10.0	8	26.7	1	3.3
21	-		-		-		-	
22	13	43.3	2	6.7	29	96.7	0	0
23	4	13.3	13	43.3	7	23.3	0	0
24	2	6.7	23	76.7	5	16.7	1	3.3
25	3	10.0	27	90.0	5	16.7	0	0
26	5	16.7	16	53.3	6	20.0	0	0
27	12	40.0	6	20.0	29	96.7	0	0
28	-		-		-		-	
29	19	63.3	4	13.3	9	30.0	2	6.7
30	29	96.7	1	3.3	8	26.7	8	26.7
31	28	93.3	6	20.0	5	16.7	22	73.3

*Sub. = Subject Rel. = Relative percentage

TABLE III

DYNAMIC WORKING CONTACTS - THE FREQUENCY OF VARIOUS QUADRANT COMBINATIONS

Maxillary Arch

Teeth	Frequency Subject	Relative*
Cuspid	22	36.6%
Cuspid, second bicuspid	6	10.0%
Cuspid, second bicuspid, first molar	1	1.6%
Cuspid, second bicuspid, first and second molars	2	3.3%
Cuspid, first molar	6	10.0%
Cuspid, first and second molars	2	3.3%
Cuspid, second bicuspid, second molar	0	
Cuspid, second molar	0	
Cuspid, central and lateral incisors	8	13.3%
Entire quadrant	2	3.3%
Cuspid, second bicuspid, incisors	1	1.6%
Cuspid, second bicuspid, first molar, incisors	1	1.6%
Cuspid, second bicuspid, first and second molars, incisors	2	3.3%
Cuspid, first molar, incisors	2	3.3%
Cuspid, second molar, incisors	2	3.3%
Cuspid, second bicuspid, second molar, incisors	1	1.6%
Other - no cuspids	2	3.3%

*Data is for right and left maxillary quadrants accounting for 60 total observed quadrants.

TABLE IV

DYNAMIC WORKING CONTACTS - THE FREQUENCY OF VARIOUS QUADRANT COMBINATIONS

Mandibular Arch

Teeth	Frequency Subject	Relative*
Cuspid	23	38.3%
Cuspid, second bicuspid	6	10.0%
Cuspid, second bicuspid, first molar	1	1.6%
Cuspid, second bicuspid, first molar, second molar	2	3.3%
Cuspid, first molar	6	10.0%
Cuspid, first and second molars	0	
Cuspid, second bicuspid, second molar	1	1.6%
Cuspid, second molar	1	1.6%
Cuspid, incisors	6	10.0%
Entire quadrant	2	3.3%
Cuspid, second bicuspid, incisors	2	3.3%
Cuspid, second bicuspid, first and second molars, incisors	2	3.3%
Cuspid, second bicuspid, first molar, incisors	1	1.6%
Cuspid, first molar, incisors	3	5.0%
Cuspid, second molar, incisors	2	3.3%
Cuspid, second bicuspid, second molar, incisors	0	
Other - no cuspids	2	3.3%

*Data is for right and left mandibular quadrants accounting for 60 total observed quadrants.

TABLE V

STATIC ANALYSIS IN PROTRUSIVE (EDGE TO EDGE) POSITION*

	Subject Frequency	Relative Frequency
Cuspids Only	0	0
The cuspids along contact, discluding the remaining dentition.		
Cuspids and Others	7	23.3%
The cuspids and some other teeth contact, discluding the remaining dentition.		
Others	23	76.7%
Teeth other than the cuspids contact, discluding the remaining dentition.		

*This position is defined as that position when the Facial surfaces of the maxillary and mandibular incisor teeth are in the same vertical plane and the incisal edges are edge to edge.

TABLE VI

STATIC ANALYSIS IN RIGHT LATERAL CUSP OVER CUSP POSITION*

	Subject Frequency	Relative Frequency
Cuspids Only	18	60.0%
The cuspids along contact, discluding the remaining dentition.		
Cuspids and Others	11	36.7%
The cuspids and some other teeth contact, discluding the remaining dentition.		
Others	1	3.3%
Teeth other than the cuspids contact, discluding the remaining dentition.		

*This position is defined as that position when the facial surfaces of the maxillary and mandibular right cuspid teeth are in the same vertical plane and the incisal edges are edge to edge.

TABLE VII

STATIC ANALYSIS IN LEFT LATERAL CUSP OVER CUSP POSITION*

	Subject Frequency	Relative Frequency
Cuspids Only	17	56.7%
The cuspids alone contact, discluding the remaining dentition.		
Cuspids and Others	10	33.3%
The cuspids and some other teeth contact, discluding the remaining dentition.		
Others	3	10.0%
Teeth other than the cuspids contact, discluding the remaining dentition.		

*This position is defined as that position when the facial surfaces of the maxillary and mandibular left cuspid teeth are in the same vertical plane and the incisal edges are edge to edge.

TABLE VIII

STATIC ANALYSIS IN BILATERAL CUSP OVER CUSP POSITION

	Subject Frequency	Relative Frequency
Cuspids Only Bilaterally	15	50.0%
The cuspids alone bilaterally contact, discluding the remaining dentition.		
Cuspids and Others Bilaterally	8	26.6%
The cuspids and some other teeth bilaterally contact, discluding the remaining dentition.		
Others Bilaterally	1	3.3%
Teeth other than cuspids bilaterally contact, discluding the remaining dentition.		
Other Than Bilaterally	6	20.1%
Static designations occurred which were not bilateral.		

TABLE IX

TEETH WITH NO CENTRIC OCCLUSION CONTACT AND NO OTHER CONTACTS IN ANY OF THE OTHER EXCURSIONS (FROM THE DYNAMIC ANALYSIS)

	Subject Frequency	Relative Frequency
No contacts	23	76.7%
No centric occlusion contact, but some other contacts.	7	23.3%
Total	30	

Tooth	Subject Frequency	Relative Frequency
3	1	4.3%
4	9	39.1%
7	11	47.8%
8	1	4.3%
9	4	17.3%
10	13	56.5%
13	6	26.1%
20	2	8.6%
23	11	47.8%
24	6	26.1%
25	3	13.1%
26	8	34.7%
29	6	26.1%

TABLE X

TEETH WITH NO CENTRIC OCCLUSION CONTACT, BUT SOME OTHER CONTACTS IN THE OTHER EXCURSIONS (FROM THE DYNAMIC ANALYSIS)

	Subject Frequency	Relative Frequency
No centric occlusion contact, but some other contact.	29	96.7%
Absent	1	3.3%
Total	30	

Tooth	Subject Frequency	Relative Frequency
2	1	3.4%
4	1	3.4%
6	18	62.0%
7	17	58.6%
8	24	82.7%
9	21	72.4%
10	15	34.4%
11	17	58.6%
13	3	10.3%
20	3	10.3%
22	15	51.7%
23	15	51.7%
24	22	75.8%
25	19	65.5%
26	17	58.6%
27	14	48.2%
28	1	3.4%
29	2	6.8%
31	1	3.4%

Table XI correlates the working side contacts and the protrusive contacts from the dynamic analysis. While the incisor teeth showed the highest incidence of contact, it should be noted that the maxillary right cuspid was the only tooth in the buccal segment to equal them.

Table XII contains data from the dynamic analysis concerning balancing side contacts. Not only was there a high incidence of balancing contacts in the subjects examined, but the second molar teeth which were primarily the causative agents.

Table XIII correlates data from subjects with both a working and balancing side contact. While there was a relatively low incidence of both working and balancing side contacts, those contacts present primarily involved the left maxillary second molar and the left mandibular first and second molars.

Correlating the static analysis contacts with the dynamic balancing contacts showed seventeen subjects who exhibited a left cuspid only designation in the static analysis, twelve (70.5%) had a contralateral balancing side contact. Of the ten who exhibited a left cuspid and other designation in the static analysis, eight (80%) had a contralateral dynamic balancing side contact. The teeth most often involved were the molars and the incisors with an equal incidence of 57.1%.

TABLE XI

SUBJECTS WITH BOTH A WORKING SIDE CONTACT AND A PROTRUSIVE CONTACT (FROM THE DYNAMIC ANALYSIS)

	Subject Frequency	Relative Frequency
Working and Protrusive	9	30.0%
Absent	21	70.0%
Total	30	

Tooth	Subject Frequency	Relative Frequency
2	3	33.3%
3	2	22.2%
4	1	11.1%
6	6	66.6%
7	5	55.5%
8	6	66.6%
9	5	55.5%
10	6	66.6%
11	3	33.3%
14	3	33.3%
15	2	22.2%
18	2	22.2%
19	2	22.2%
22	1	11.1%
23	6	66.6%
24	5	55.5%
25	5	55.5%
26	6	66.6%
27	4	44.4%
28	1	11.1%
31	3	33.3%

TABLE XII

SUBJECTS WITH BALANCING CONTACTS
(FROM THE DYNAMIC ANALYSIS)

	Subject Frequency	Relative Frequency
Balancing Contacts	25	83.3%
No Balancing Contacts	5	16.7%
Total	30	

Tooth	Subject Frequency	Relative Frequency
2/31	22	88%
3/30	7	28%
4/29	2	8%
13/20	1	4%
14/19	7	28%
15/18	19	76%

TABLE XIII

SUBJECTS WITH BOTH A WORKING AND BALANCING SIDE CONTACT (FROM THE DYNAMIC ANALYSIS)

	Subject Frequency	Relative Frequency
Working and Balancing	9	30.0%
Absent	21	70.0%
Total	30	

Tooth	Subject Frequency	Relative Frequency
2	2	22.2%
3	2	22.2%
4	2	22.2%
14	2	22.2%
15	5	55.5%
18	6	66.6%
19	4	44.4%
29	2	22.2%
30	2	22.2%
31	2	22.2%

Of the eighteen subjects who exhibited a right cuspid only designation in the static analysis, eleven had a contralateral dynamic balancing side contact. Of the eleven who exhibited a right cuspid contact and other designation in the static analysis, seven had a contralateral dynamic balancing side contact. The teeth most often involved (75%) were the left maxillary and mandibular first molars.

Tables XIV and XV contain information as to the centric relation analysis, the teeth involved in the intercept and the slide direction after the intercept. It should be noted that a high frequency of intercept did occur and while the second molar teeth showed the highest evidence of contact, no correlation seemed to exist with the direction of the slide.

Only three of thirty subjects experienced some pain, but of the three, two had balancing side contacts, an intercept in the retruded position and crepitus. These two were also part of a group of eight who elicited some noise. Seven of the eight had some balancing side contacts and six had an intercept in the retruded position.

While three of the thirty clenched or ground their teeth, all three had some balancing side contacts and an intercept in the retruded position.

Twenty-nine of the thirty subjects exhibited faceting on the occlusal surfaces or incisal edges of their teeth.

TABLE XIV

CENTRIC RELATION ANALYSIS

	Subject Frequency	Relative Frequency
Intercept	26	86.7%
No Intercept	4	13.3%
Total	30	

(This data is to reflect the difference in the coincidence of centric relation and centric occlusion.)

Tooth		Subject* Frequency	Relative Frequency
2	31	7	26.9%
3	30	3	11.5%
4	29	5	19.3%
11	22	3	11.5%
14	19	5	19.3%
15	18	3	11.5%

*Teeth involved in the 26 subjects who exhibited an intercept between centric relation and centric occlusion.

TABLE XV

SLIDE DIRECTION AFTER THE INTERCEPT*

Direction	Frequency Sub.	Rel.	Tooth		Frequency Sub.	Rel.
Anterior	9	34.6%	2	31	1	11.1%
			3	30	2	22.2%
			4	29	3	33.3%
			14	19	2	22.2%
			15	18	1	11.1%
Anterior and Right	8	30.8%	2	31	3	37.5%
			3	30	1	12.5%
			11	22	3	37.5%
			15	18	1	12.5%
Anterior and Left	7	26.9%	2	31	2	28.5%
			4	29	2	28.5%
			14	19	2	28.5%
			15	18	1	14.5%
Anterior Right and Left	2	7.8%	2	31	1	50.0%
			14	19	1	50.0%

*The slide direction of the intercept between centric relation and centric occlusion and the teeth involved for the 26 subjects who exhibited an intercept.

CHAPTER V

DISCUSSION

Review of the Dynamic Analysis Data

Centric Occlusion

An extremely high incidence of centric occlusion contacts was seen in the first and second molars (97.1%). The second bicuspid was somewhat less at 65.8% and the cuspids were still less at 43.3%. The least amount of contact was shown by the incisors at 12.1%.

Clinical Implication

The lack of centric occlusion contacts of the second bicuspids was due to both incorrect gingivo-occlusal band positioning and poor tooth positioning as a result of space closure. To correct this the bicuspids should be banded more gingivally and should be finished in a more upright position to allow for a small degree of relapse.

Protrusive

Protrusive movement data showed an extremely high incidence of contact of the central incisors (86.7%). The lateral incisors less at 44.9%, while the maxillary cuspids contacted only 18.3% and the mandibular bicuspids and molars were about equal with a mean of 13.3%.

Clinical Implication

Orthodontists strive for posterior disclusion by anterior occlusion in protrusive movements of the mandible. When this contact does not occur equally in the anterior region, it is due to improper positioning of the anterior teeth due either to lack of sufficient overbite and overjet or insufficient lingual root torque. The cuspids should contact the mandibular bicuspid, and this can only be effected if the bicuspid is in a more buccal position in the arch. This position is achieved by either a large buccal offset at the bicuspid in the archwire or a predetermined position set in the bracket.

Working

In the following discussion, values given are for the maxillary and mandibular arches combined. The incisors contacted 20.0% of the time on the working side, while the cuspids contacted 96.7% of the time. The second bicuspid's incidence of contact was 26.7%. The first molars exhibited a higher incidence at 35.1% than the second molar at 18.4%.

Clinical Implication

Orthodontically subjects were treated to achieve a canine protected occlusion. When other teeth contact it was due to incorrect positioning or torque or a combination of both.

Balancing

These values are given for the maxillary and mandibular arches combined. The central incisors contacted but once for a 3.3% incidence, but neither the lateral incisors nor the cuspids had any contact on the balancing side. The second bicuspids exhibited a 5.0% incidence of contact, while the first molars had contact 26.6% of the time. The second molars exhibited the highest contact percentage at 66.7%. The right second molar contacts were higher at 71.6%, than the left second molars at 61.6%.

Clinical Implication

Second molars were in the highest evidence because they frequently are not banded in treatment and therefore have insufficient buccal root torque on the upper molars and insufficient lingual root torque on the lower molars. The difference between the sides exists because of the higher number of right handed Orthodontists who consistently view the subject from the right side, and are more aware of the subject's left quadrants.

Review of the Analysis of Quadrant Dynamic Working Contacts

It should be noted that the data presented is for both the right and left quadrants, accounting for sixty observed quadrants. The highest incidence of working contacts in the maxillary arch involves the cuspid

working alone (36.6%). Cuspids and incisors have the next highest incidence at 13.3%, followed by the cuspid in combination separately with the second bicuspid and first molar at 10.0%. The remaining combinations all have a frequency of less than 4.0% each.

The mandibular arch is similar to the maxillary arch in that the cuspid working alone had the highest incidence of contact at 38.3%. The next combinations are again the cuspid and the second bicuspid and the cuspid and the first molar (10.0%). Also at the 10.0% incidence level was the cuspid and incisor combination. The remaining combinations again all had a frequency of 5.0% or less.

Clinical Implication

The higher incidence of cuspid alone quadrant working contacts is further evidence that the Orthodontist strives for a cuspid protected occlusion on the working side. The fact that the next highest incidence involves incisors with cuspids indicated either poor positioning, or insufficient lingual root torque, or a combination of both, of the incisor teeth.

In the subsequent discussion the following groups are referred to:

Group A. Refers to the thirty Orthodontically treated subjects who had four first bicuspid teeth extracted as part of therapy.

Group B. Refers to the thirty Orthodontically treated subjects who had no extractions as a part of therapy. (Bohl,

Group Comparisons

Protrusive

The protrusive contacts of the maxillary and mandibular central incisors of the three groups showed minor differences. The maxillary lateral incisors of Group A (42.1%), and Group C (43.5%) were quite similar in their contacts. However, Group B (13.3%) had less than one third the number of contacts. The mandibular lateral incisors of Group A (48.3%), and Group B (46.6%) varied slightly, but Group C (58.0%) exhibited a somewhat higher frequency of contacts.

The incidence of the contacts of the maxillary cuspids of the three groups varied from each other by less than ten percent. The mandibular cuspid contacts showed considerable differences in that the frequency of Group C (12.4%) was four times greater than the frequency of Group A (31.5%), which was ten times greater than the frequency of Group B (3.3%).

The contacts of the mandibular second bicuspids of Groups A (11.6%) and C (12.5%) were very similar, but Group B (5.0%) was less than fifty per cent as prevalent.

1976) (For Tables see Appendix B.)

Group C. Refers to the one hundred non-Orthodontically treated subjects. (Bohl, 1974) (For Tables see Appendix C.)

The contacts of the maxillary second bicuspids of Group A (1.65%), Group B (0), and Group C (7.0%) all showed minimal contacts. The same was true for maxillary molar contacts, which varied by less than three percent.

The mandibular molar contacts of Group A (13.3%) and Group C (12.0%) were similar while Group B did not have any contacts.

The following discussions include values for both the maxillary and mandibular arches.

Centric Occlusion

The centric occlusion contacts of the molars in all three groups were quite similar in that the variance between them was less than .03%.

The second bicuspids showed a considerable variation in contacts. Group B (91.6%) and Group C (96.0%) had a ninty percentile incidence of contacts whereas Group A's incidence was in the sixty percentile bracket (65.8%). The cuspid contacts of Group A (43.3%) and Group B (40.8%) were quite similar, but Group C (58.3%) contacts were higher.

The contacts of Groups A (12.1%) and B (19.6%) were similar, while Group C (41.4%) contacts were considerably higher.

Working

The incisor working contacts of Group A (20.3%) were two and one half times that for Group B (8.3%) while Group C (14.0%) fell midway

between them. The cuspid contacts for all three groups were extremely high with a small variance between them.

The second bicuspid contacts for Group A (26.7%) and Group B (20.8%) were similar but Group C (47.0%) evidenced twice the number of contacts.

First molar contacts of Group A (35.1%) and Group C (45.8%) showed a ten percent difference whereas Group B (13.3%) showed more than a twenty-five percent difference.

The second molar contacts of Group A (18.4%) and Group C (25.5%) showed minimal differences but Group B (3.3%) had considerably fewer contacts.

Balance

The central incisors, lateral incisors, cuspids and second bicuspids balancing contacts of all three groups were all minimal and quite similar.

The first molar balancing contacts of Group B (16.6%) were the lowest progressing upward to Group A (28.6%) and to Group C (39.5%).

The second molar balancing contacts showed the widest range of difference between the three groups. Group C (74.0%) was the highest, Group B (48.3%) was the lowest frequency and Group A (66.7%) about midway between the two.

The other studies previously mentioned in the review of literature are more aptly compared to the static analysis portion of this study later in the text.

Chi Square Group Comparisons

Using an independent Chi Square statistical analysis, the three groups when compared to each other showed a significant difference at the five per cent level. When the groups were taken individually and compared to each other, Group A versus B, and Group A versus C showed significant differences.

When the groups were compared again using a Chi Square statistical analysis for each of the movements individually, only the balancing movement contacts showed not to be significantly different between the groups. The groups were then compared separately to each other and in the analysis of Groups A and B, both centric occlusion and working movements were shown not to be statistically significant differences from group to group was evidenced. However, when Groups A and C were compared statistically, the contacts in centric occlusion were statistically different while working and protrusive were not (see Tables in Appendix A).

In the final independent Chi Square statistical analysis, the individual teeth were compared between the groups. Only tooth eight

contacts, the maxillary right central incisor, and tooth eighteen contacts, the mandibular left second molar, proved to be statistically different. However, as was evidenced from the frequencies, a number of teeth had differences in contacts but were not significant at the five per cent level. While teeth eight and eighteen both showed significant statistically differences in a comparison of the three groups, when Groups A and B were compared only tooth eighteen showed significant difference, but when Groups A and C were compared only tooth eight showed a significant difference.

Group Comparisons - Pain, Noise, Balancing Contacts, Centric Relation Faceting

In a comparison of pain of the temporomandibular joint of the three groups, Group A and Group C averaged 8.5% of the subjects with some pain, while Group B had no subjects with pain.

When comparing noise of the temporomandibular joint, an average 27.2% of Group A and Group C exhibited some noise, while Group B was lower at 13.3%.

Comparisons of balancing side contacts showed Group C (91.0%) exhibiting the highest frequency with Group A (83.3%) and Group B (76.6%) slightly lower.

In a comparison of intercepts between centric relation and centric occlusion, Group A (86.6%) exhibited the lowest incidence,

however, Group B (90.0%) and Group C (92.0%) while slightly higher were still quite similar.

Faceting of the occlusal surfaces or the incisal edges of the teeth was essentially the same in the three groups (98.2%).

An independent Chi Square statistical analysis showed no signficant difference in pain, noise, balancing contacts, intercepts, and faceting (see Tables in Appendix A).

Review of Centric Relation Analysis

Twenty-six of thirty subjects reflected a difference in the coincidence of centric relation and centric occlusion contacts. The teeth most frequently involved were the right second molars (26.9%) and then equally the right second bicuspids and left first molars (19.3%).

Clinical Implication

Orthodontically subjects were not treated to a centric relation position or if they were, they were not equilibrated to eliminate the intercepts. The posterior teeth involved had prematurities due to positioning, resulting from tipping rather than bodily movement during space closure.

Review of Slide Direction After the Intercept

The direction of the slide after the intercept was relatively equally divided between anterior (34.6%), anterior and right (30.8%),

and anterior and left (26.9%). There was no definite pattern as to which teeth were involved.

Clinical Implication

The clinical implications have previously been stated in the review of centric relation analysis.

Analysis of Pain and Noise

The relatively low incidence of pain and noise in these subjects may be attributable to the young ages of the subjects. No significance may be placed upon their relationship.

Analysis of Clench or Grind

The relatively low incidence of clenching or grinding (10%) is in direct contrast to high percentile (60%) reported by Weinberg in 1961.

Analysis of Faceting

The extremely high precentage (96.7%) of faceting exhibited is similar to Weinberg's 1961 study (84%), but significantly higher than that reported by Scaife and Holt in their 1969 study (25.4%).

Review of the Analysis of Working and Protrusive Contacts

Thirty per cent of the subject exhibited teeth with both a working and a protrusive contact. The teeth most frequently involved (66.6%)

were the maxillary right cuspid, and central incisor and the mandibular left lateral incisor and right cuspid.

Clinical Implication

The incisors and the cuspids should contact in a protrusive movement, however the incisors should not contact in a working movement. The working movement contact can be attributed to either incorrect positioning of the incisors or insufficient lingual root torque or a combination of both.

Review of the Analysis of Dynamic Balancing Contacts

Twenty-five of the thirty subject exhibited some balancing side contacts. The teeth most frequently involved (88.0%) were the maxillary and mandibular right second molars. It must be noted that while a large percentage of the subjects had balancing side contacts, they were not evidenced throughout the entire range of movements.

Clinical Implication

Universally, balancing side contacts are felt to have a deletrious effect on a properly balanced occlusion and the Orthodontic clinical implication has been previously discussed in the Dynamic Analysis Balancing Contacts.

Review of the Analysis of Dynamic Working and Balancing Contacts

Thirty per cent of the subjects had both working and balancing contacts. The tooth most frequently involved (66.6%) was the mandibular second molar.

Clinical Implication

The clinical implication here has been discussed previously in the sections on working and balancing contacts.

Weinbert (1964) and Ingervall (1972) recorded a substantially low incidence (18%) of canine protected occlusion than did Scaife and Holt (1969), or this study which both averaged a 57% occurrence. The significant difference may be as a result of the positional observance. Though Weinberg did not report a bilateral finding, the same variance is evident between the other three.

An independent Chi Square statistical analysis showed no significant difference in a comparison of: the entire group, the individual designations (cuspids only, cuspid and other, other), and the individual designations and positions (protrusive, right lateral and left lateral) (see Tables in Appendix A).

Review of Subjects Whose Teeth Exhibited No Contacts in Centric Occlusion

Twenty-three of the thirty subjects had teeth with no centric occlusion contacts and no other contacts in any other excursions. The teeth most frequently involved (47. 8%) were the maxillary right lateral incisor and the mandibular left lateral incisor.

Twenty-nine of the thirty subjects has teeth with no centric occlusion contacts but had contact in some excursions. The teeth most frequently involved (77. 7%) were the maxillary central incisors.

Clinical Implication

When centric occlusion contacts are lacking in the posterior teeth, it was due to insufficient intercuspation of the teeth from incorrect banding or failing to use elastics to bring the buccal segments together. Lack of any contacts will have a deletrious effect on those teeth contacting, for the pressures of occlusion are improperly distributed.

Review of the Static Analysis Data

In a Protrusive (edge to edge) position, 76. 7% of the subjects had teeth other than the cuspids which discluded the remaining dentition. In a right lateral cusp over cusp position, 60% of the subjects had exclusive cuspid function. In a left lateral cusp over cusp position, 56. 7% of the subjects had exclusive cuspid function. Bilaterally 50% of the subjects exhibited an exclusive cuspid function.

Group Comparisons

In a Protrusive (edge to edge) position, Group B (86.6%) had a ten per cent higher incidence of disclusion by teeth other than the cuspid than Group A (76.6%) and six per cent higher than Group C (80.0%).

In a right lateral cusp over cusp position, Group A (60.0%), Group B (63.3%), and Group C (64.0%) were quite similar in exhibiting an exclusive cuspid function.

In a left lateral cusp over cusp position, Group A (56.6%) and Group C (54.0%) again showed a great deal of similarity in an exclusive cuspid function, its frequency was somewhat higher at 66.6%.

An independent Chi Square statistical analysis showed no significant difference for the entire group, the individual designations (cuspids only, cuspid and other, other), and the individual designations and positions (protrusive, right lateral and left lateral), (see Tables in Appendix A).

Future of the Study

The study accomplished what it was intended to do. However, several areas may be investigated to improve it. The use of a cellophane strip on a forceps may tend to distort the findings in that a foreign object is introduced into the mouth. A more effective method of detection other than a tactile sense may produce a more accurate finding. Secondly,

since occlusal contacts occur along an entire surface, a more accurate means of measurement could be devised to record these contacts at various points along the surface.

A more meaningful method of pre and post treatment classification could be defined, either using the cuspids as suggested by Malone (1970) or by employing a combination skeletal and dental classification.

This study should be conducted as a longitudinal rather than a cross-sectional study. Subjects could be examined: a. just before the finish of active Orthodontic treatment; b. six months and one year subsequent to band removal; c. prior to the removal of retentive devices; and d. six months and one year later.

SUMMARY

After selection of the subjects, their tooth contacts were checked both visually and with a thin piece of cellophane held with a pair of locking forceps by the investigator. Contact was evidenced by the inability of the investigator to remove the cellophane. Centric occlusion, protrusive, a working and balancing tooth were recorded.

In centric occlusion while the molars had a high percentile of occlusal contacts (97%), the second bicuspids were relatively low (65%). This is indicative of improper tooth positioning either due to space closure, and/or improper band positioning.

Protrusive occlusion was primarily a function of the maxillary and mandibular central incisors. The remaining anterior teeth showed less than half the number of contacts of the central incisors. The unequal contact is due to improper positioning of the anterior teeth either due to lack of sufficient overbite and overjet, and/or insufficient lingual root torque.

Dynamic occlusal contacts showed an extremely high percentage (86%) of cuspid protected occlusion. There is ample evidence that the guide should be a more pragmatic criterion for successful case completion.

On the balancing side second molars exhibited a high percentage of contacts. The causative agents here are insufficient buccal root torque of the maxillary molar, and/or insufficient lingual root torque of the mandibular molar. That fact that more contacts were seen on the right side is evidence that since most Orthodontists view their patients from the right side, they are more aware of the teeth in the patient's left quadrants.

When the results were gathered, a statistical analysis was undertaken to compare the tooth contacts of the orthodontically treated extraction subjects to the tooth contacts of the orthodontically treated non-extraction subjects and to non-orthodontically treated subjects.

In a comparison of the Orthodontic and Non-Orthodontic groups in centric occlusion, the largest difference between the three is seen in the second bicuspid contacts. Other than the second bicuspids, the Orthodontic groups were very similar: but in comparing the Orthodontic extraction group to the Non-Orthodontic group, other than the bicuspids, the Orthodontic group had less contact of anterior teeth.

Comparing the protrusive contacts of the three groups, the Orthodontic extraction group and the Non-Orthodontic group had minimal differences. The Orthodontic groups varied in that the extraction group had a higher number of contacts of maxillary lateral incisors and mandibular cuspids than the non-extraction group.

The working contacts of the three groups were similar in that they all showed an extremely high percentage of cuspid contact. However, the Orthodontic extraction group and the Non-Orthodontic group differed from the Orthodontic non-extraction group in having more incisor contact and considerably more molar and bicuspid contacts.

The two Orthodontic groups contrasted each other in that the extraction group exhibited a much higher number of balancing contacts. The Orthodontic extraction group and the Non-Orthodontic groups were quite similar with the later having a somewhat higher number of balancing contacts on the posterior teeth.

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APPENDIX A

APPENDIX A

TABLE I

Dynamic Analysis

Group Comparisons*

Protrusive	A	B	C
Maxillary Central Incisors	90.0%	96.6%	97.0%
Mandibular Central Incisors	86.7%	86.6%	88.0%
Maxillary Lateral Incisors	42.1%	13.3%	43.5%
Mandibular Lateral Incisors	48.3%	46.6%	58.0%
Maxillary Cuspids	18.3%	10.0%	25.5%
Mandibular Cuspids	31.5%	3.3%	12.4%
Maxillary Second Bicuspids	1.65%	0	7.0%
Mandibular Second Bicuspids	11.6%	5.0%	12.5%
Maxillary Molars	13.3%	10.0%	10.5%
Mandibular Molars	13.3%	0	12.0%

Centric Occlusion

All values listed below are for both the maxillary and mandibular arches.

	A	B	C
Molars	97.1%	97.9%	99.5%
Second Bicuspids	65.8%	91.6%	96.0%
Cuspids	43.3%	40.8%	58.3%
Incisors	12.1%	19.6%	41.4%

*A = 30 Orthodontically Treated Extraction Subjects
B = 30 Orthodontically Treated Non-Extraction Subjects
C = 100 Non-Orthodontically Treated Subjects

APPENDIX A

TABLE I

Dynamic Analysis

Group Comparisons*

Working

All values listed below are for both the maxillary and mandibular arches.

	A	B	C
Incisors	20.0%	8.3%	14.0%
Cuspids	96.7%	98.3%	97.8%
Second Bicuspids	26.7%	20.8%	47.0%
First Molar	35.1%	13.3%	45.8%
Second Molar	18.4%	3.3%	25.5%

Balance

All values listed below are for both the maxillary and mandibular arches.

	A	B	C
Central Incisors	3.3%	0	1.3%
Lateral Incisors	0	0	0
Cuspids	0	0	0
Second Bicuspids	5.0%	3.3%	7.0%
First Molars	26.6%	16.6%	39.5%
Second Molars	66.7%	48.3%	74.0%

*A = 30 Orthodontically Treated Extraction Subjects
B = 30 Orthodontically Treated Non-Extraction Cases
C = 100 Non-Orthodontic Subjects

APPENDIX A

TABLE II

Chi Square Comparison of the Dynamic Analysis of *Group A, Group B, and Group C for the Entire Groups

	X^2	DF	P .05 Level
Group A	3915.25	81	P 103.01 reject
Group B			
Group C			
Group A	1632.35	81	P 103.01 reject
Group B			
Group A	3028.13	81	P 103.01 reject

*Group A = 30 Orthodontically Treated Extraction Subjects
Group B = 30 Orthodontically Treated Non-Extraction Subjects
Group C = 100 Non-Orthodontically Treated Subjects

APPENDIX A

TABLE III

Chi Square Comparison of the Dynamic Analysis of *Group A, Group B, and Group C for each Movement

	X^2	DF	P .05 Level
Groups A, B, and C			
Centric Occlusion	147.65	54	P 72.13 reject
Protrusive	96.75	54	P 72.13 reject
Working	146.85	54	P 72.13 reject
Balancing	24.13	54	P 72.13 accept
Groups A and B			
Centric Occlusion	7.53	23	P 35.17 accept
Protrusive	48.42	23	P 35.17 reject
Working	29.64	23	P 35.17 accept
Groups A and C			
Centric Occlusion	42.32	23	P 35.17 reject
Protrusive	16.83	23	P 35.17 accept
Working	20.53	23	P 35.17 accept

*Group A = 30 Orthodontically Treated Extraction Subjects
Group B = 30 Orthodontically Treated Non-Extraction Subjects
Group C = 100 Non-Orthodontically Treated Subjects

APPENDIX A

TABLE IV

Chi Square Comparison of the Dynamic Analysis of *Group A, Group B, and Group C for Each Tooth

Groups A, B, C Tooth	X^2	DF	P .05 Level	Frequency
2	6.86	6	P 12.57	.333
3	9.82		P 12.57	.132
4	5.06		P 12.57	.535
6	2.62		P 12.57	.874
7	5.40		P 12.57	.491
8	18.42		P 12.57	.005
9	11.66		P 12.57	.070
10	7.17		P 12.57	.127
11	4.15		P 12.57	.649
13	5.41		P 12.57	.491
14	12.18		P 12.57	.058
15	11.37		P 12.57	.077
18	13.33		P 12.57	.038
19	9.50		P 12.57	.147
20	8.11		P 12.57	.229
22	9.99		P 12.57	.120
23	4.08		P 12.57	.673
24	10.35		P 12.57	.110
25	12.05		P 12.57	.060
26	5.03		P 12.57	.546
27	9.78		P 12.57	.130
29	6.64		P 12.57	.354
30	11.39		P 12.57	.154
31	9.22		P 12.57	.161
Groups A, B				
8	2.40	3	P 7.82	accept
18	13.38	3	P 7.82	reject

TABLE IV
(Continued)

Groups A, C					
8	14.66	3	P	7.82	reject
18	1.44	3	P	7.82	accept

*Group A = 30 Orthodontically Treated Extraction Subjects
Group B = 30 Orthodontically Treated Non-Extraction Subjects
Group C = 100 Non-Orthodontically Treated Subjects

APPENDIX A

TABLE V

Static Analysis

Group* Comparisons

	A	B	C	A	B	C	A	B	C
Cuspids Only	0	0	0	18 60.0%	19 63.3%	64	17 56.6%	20 66.6%	54
Cuspid and Other	7 23.3%	4 13.3%	20	11 36.6%	10 33.3%	29	10 33.4%	7 23.4%	42
Other	23 76.7%	26 86.0%	80	1 3.4%	1 3.4%	7	3 10.0%	3 10.0%	4

*A = 30 Orthodontically Treated Extraction Subjects
B = 30 Orthodontically Treated Non-Extraction Subjects
C = 100 Non-Orthodontically Treated Subjects

APPENDIX A

TABLE VI

Chi Square Comparison of Static Analysis of Group A*, Group B, and Group C

	X^2	DF	P .05 Level
As Groups	15.02	16	P 26.3 accept
Designations			
Cuspid Only	.369	4	P 9.49 accept
Cuspids and Others	2.52	4	P 9.49 accept
Others	3.009	4	P 9.49 accept
Designation and Position			
Protrusive	1.02	4	P 9.49 accept
Right Lateral	1.47	4	P 9.49 accept
Left Lateral	5.13	4	P 9.49 accept

*Group A = 30 Orthodontically Treated Extraction Subjects
Group B = 30 Orthodontically Treated Non-Extraction Subjects
Group C = 100 Non-Orthodontically Treated Subjects

APPENDIX A

TABLE VII

Group* Comparisons

Pain, Noise, Balancing Contacts, Intercept, Faceting

	Pain	Noise	Balancing Contact	Intercept	Faceting
A	3 10.0%	8 26.7%	25 83.3%	26 86.6%	29 96.6%
B	0	4 13.3%	23 76.6%	27 90.0%	30 100.0%
C	7	27	91	92	98

*A = 30 Orthodontically Treated Extraction Subjects
B = 30 Orthodontically Treated Non-Extraction Subjects
C = 100 Non-Orthodontically Treated Subjects

APPENDIX A

TABLE VIII

Chi Square Comparison of Pain, Noise, Balancing Contacts, Intercepts, and Faceting of Group* A, Group B and Group C

	X^2	DF	P .05 Level
Pain, Noise, Balancing Contacts, Intercepts, Faceting	5.46	8	P 15.51

*Group A = 30 Orthodontically Treated Extraction Subjects
Group B = 30 Orthodontically Treated Non-Extraction Subjects
Group C = 100 Non-Orthodontically Treated Subjects

APPENDIX B

APPENDIX B

TABLE I

Dynamic Analysis 30 Subjects Tooth Contact Totals

Orthodontically Treated Non-Extraction

Maxillary Arch

Tooth Number	Centric Occlusion	Protrusive	Working	Balancing
2	29	0	2	15
3	29	0	3	5
4	28	0	6	2
5	25	0	14	2
6	12	3	30	0
7	7	5	1	0
8	6	30	4	0
9	5	28	2	0
10	7	3	3	0
11	12	3	29	0
12	27	1	14	0
13	27	0	6	0
14	30	0	5	5
15	29	0	0	14

APPENDIX B

TABLE II

Dynamic Analysis 30 Subjects Tooth Contact Totals

Orthodontically Treated Non-Extraction

Mandibular Arch

Tooth Number	Centric Occlusion	Protrusive	Working	Balancing
18	29	0	0	14
19	30	0	5	5
20	27	1	4	0
21	28	3	13	0
22	12	2	29	0
23	7	13	3	0
24	4	23	2	0
25	5	28	4	0
26	6	15	1	0
27	13	0	30	0
28	24	3	14	2
29	28	0	9	2
30	29	0	3	5
31	30	0	2	15

APPENDIX B

TABLE III

Static Analysis	30 Subjects	
Orthodontically Treated Non-Extraction		
	Frequency Subject	Relative
I. Protrusive		
Cuspids Only	0	
Cuspids and Other	4	13.3%
Other	26	86.7%
II. Right Lateral Cusp-Over-Cusp		
Cuspids Only	19	63.3%
Cuspids and Other	10	33.3%
Other	1	3.4%
III. Left Lateral Cusp-Over-Cusp		
Cuspids Only	20	66.6%
Cuspids and Other	7	23.4%
Other	3	10.0%
IV. Bilateral		
Cuspids Only		
Cuspids and Other		
Other		
Different Bilaterally		

APPENDIX B

TABLE IV

Pain, Noise, Balancing Side Contacts, Faceting, Intercept

Subjects Eliciting Pain or Noise in the Temporomandibular Joint

3 (10%) Subjects elicited pain

4 (13.3%) Subjects elicited noise

Subjects Whose Teeth Had Balancing Side Contacts

Subjects Whose Teeth Showed Faceting

30 (100%) Subjects had faceting

Subjects Who Had an Intercept in the Retruded Position

27 (90%) Subjects had an intercept

APPENDIX C

APPENDIX C

TABLE I

Dynamic Analysis

Maxillary Arch Tooth Contact Totals 100 Subjects

Tooth Number	Centric Occlusion	Protrusive	Working	Balancing
2	99	8	23	74
3	100	11	41	39
4	96	9	44	9
5	97	12	78	10
6	53	23	98	0
7	41	44	21	0
8	48	98	9	0
9	46	96	11	2
10	48	43	20	0
11	59	28	99	0
12	93	14	74	6
13	96	5	40	6
14	100	11	51	41
15	99	12	27	74

APPENDIX C

TABLE II

Dynamic Analysis

Mandibular Arch Tooth Contact Totals 100 Subjects

Tooth Number	Centric Occlusion	Protrusive	Working	Balancing
18	99	14	28	74
19	100	9	50	40
20	96	13	49	6
21	93	22	69	4
22	62	32	96	0
23	35	55	17	0
24	39	92	11	2
25	37	84	6	1
26	37	61	15	0
27	59	31	98	0
28	96	20	73	4
29	96	12	55	7
30	100	13	41	38
31	99	12	24	74

APPENDIX C

TABLE III

Static Analysis	100 Subjects	
	Frequency Subject	Relative
I. Protrusive Edge to Edge		
Cuspids Only	0	
Cuspids and Other	20	20.0%
Other	80	80.0%
II. Right Lateral Cusp-Over-Cusp		
Cuspids Only	64	64.0%
Cuspids and Other	29	29.0%
Other	7	7.0%
III. Left Lateral Cusp-Over-Cusp		
Cuspids Only	54	54.0%
Cuspids and Other	42	42.0%
Other	4	4.0%
IV. Bilateral		
Cuspids Only	49	49.0%
Cuspids and Other	25	25.0%
Other	2	2.0%
Different Bilaterally	24	24.0%

APPENDIX C

TABLE IV

Pain, Noise, Balancing Side Contacts, Faceting, Intercept

Subjects Eliciting Pain or Noise in the Temporomandibular Joint

7 Subjects elicited pain

27 Subjects elicted noise

Subjects Whose Teeth Had Balancing Side Contacts

91 Subjects had balancing side contacts

Subjects Whose Teeth Showed Faceting

98 Subjects had faceting

Subjects Who Had an Intercept in the Retruded Position

92 Subjects has an intercept

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TABLE I

General Health of the Subjects

	Subject Frequency	Relative Frequency
Not under Physician's care	27	90.0%
Under Physician's care	3	10.0%
Total	30	
Type of treatment		
Upper Respiratory Infection		1
Pregnancy		1
Acne		1
Total		3
Medication		
Antibiotics		1
Iron pills		1
Pills for Acne		2
Total		4

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TABLE II

ANB Angle

Difference	Subject Frequency	Relative Frequency
1	1	3.3%
2	1	3.3%
3	9	30.0%
4	6	20.0%
5	13	43.3%
Total	30	

SNA: Is a cephlametric measurement which relates the maxillary denture base to the cranial anatomy.

SNB: Is a cephlametric measurement which relates the mandibular denture base to the cranial anatomy.

ANB: Is the mathematical difference between SNA and SNB.

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TABLE III

	Subject Frequency	Relative Frequency
No Equilibration	26	86.7%
Equilibration	4	13.3%
Total	30	

Subject	Teeth Equilibrated
27, 30	8, 9
16	7
22	6, 7, 8, 9, 10, 11, 22, 23, 24, 25, 26, 27

*Subjects whose teeth had been equilibrated.

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TABLE IV

Satisfaction with the Orthodontic Treatment Result

	Subject Frequency	Relative Frequency
Pleased	28	93.3%
Displeased	2	6.7%

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TABLE V

Pretreatment Angle's Classification of Cuspids and First Molars

Tooth	Classification	Subject Frequency	Relative Frequency
Right Cuspid	I	7	23.3%
	II	23	76.7%
Left Cuspid	I	6	20.0%
	II	24	80.0%
Right First Molar	I	11	36.7%
	II	19	63.3%
Left First Molar	I	8	26.7%
	II	22	73.3%

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TABLE VI

Postreatment all cuspids and first molars were in Angle's Class I relationship at the time of examination.

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TABLE VII

	Subject Frequency	Relative Frequency
Right side contacts	6	75.0%
Left side contacts	2	25.0%

Right Side Contacts	Subject Frequency	Relative Frequency
Tooth		
2/31	6	60.0%
3/30	3	30.0%
4/29	1	10.0%

Left Side Contacts	Subject Frequency	Relative Frequency
Tooth		
13/20	0	0
14/19	1	33.3%
15/18	2	66.6%

*Subjects with Unilateral Balancing side contacts, from the Dynamic Analysis.

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TABLE VIII

	Subject* Frequency	Relative Frequency
Bilateral Balancing Contacts	17	68.0%
Not Bilateral Balancing Contacts	8	32.0%
Total	25	

Tooth	Subject Frequency	Relative Frequency
2/31	16	94.1%
2/30	5	29.4%
4/29	1	5.8%
13/20	1	5.8%
14/19	6	35.2%
15/18	17	100.0%

*Subjects with bilateral balancing side contacts, from the Dynamic Analysis.

APPENDIX D

TABLE IX

	Subject* Frequency	Relative Frequency
Both Balancing and Protrusive	9	30.0%
Absent	21	70.0%
Total	30	

Tooth	Subject Frequency	Relative Frequency
2	2	22.2%
8	1	11.1%
14	2	22.2%
15	5	55.5%
18	5	55.5%
19	2	22.2%
24	1	11.1%
31	3	33.3%

*Subjects with both a balancing side contact and a protrusive contact, from the Dynamic Analysis.

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TABLE X

	Subject Frequency	Relative Frequency
Pain and balancing side contacts	2	6.6%
No pain and balancing side contacts	28	93.4%
Total	30	

Subject	Tooth
25	2/31, 14/19, 15/18
20	3/30, 4/29, 13/20, 14/19, 15/18

*Subjects with both pain and balancing side contacts and the teeth involved on the balancing side.

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TABLE XI

	Subject Frequency	Relative Frequency
Pain and intercept	2	6.6%
No pain and intercept	28	93.4%
Total	30	

Subject	Tooth	Direction
20	3/30	Anterior and Right
25	3/30	Anterior and Right

*Subjects with both pain and an intercept between centric relation and centric occlusion, and the teeth involved.

APPENDIX D

TABLE XII

	Subject Frequency	Relative Frequency
Noise and pain	2	6.6%
No noise and pain	28	93.4%
Total	30	

*Subjects with both noise and pain of the temporomandibular joint.

APPENDIX D

TABLE XIII

	Subject* Frequency	Relative Frequency
Balancing side contacts and noise	7	23.3%
No balancing side contacts and noise	23	76.7%
Total	30	

Tooth	Subject Frequency	Relative Frequency
2/31	5	71.4%
3/30	3	42.8%
4/29	1	14.2%
13/20	1	14.2%
14/19	2	28.5%
15/18	4	57.1%

*Subjects with both noise of the temporomandibular joint and balancing side contacts, and the teeth involved.

APPENDIX D

TABLE XIV

	Subject* Frequency	Relative Frequency
Noise and intercept	6	20.0%
No noise and intercept	24	80.0%
Total	30	

Tooth	Subject Frequency	Relative Frequency
2/31	2	33.3%
3/30	2	33.3%
11/22	1	16.6%
14/19	1	16.6%

*Subjects with noise of the temporomandibular joint and an intercept between centric occlusion and centric relation and the teeth involved.

APPENDIX D

TABLE XV

	Subject* Frequency	Relative Frequency
Clench or grind and intercept	3	10.0%
No clench or grind and intercept	27	90.0%
Total	30	

Tooth	Subject Frequency	Relative Frequency
4/29	1	33.3%
14/19	1	33.3%
2/31	1	33.3%

*Subjects who elicited the symptoms of clenching or grinding and also had an intercept between centric relation and centric occlusion.

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TABLE XVI

	Subject* Frequency	Relative Frequency
Clench, grind and balance	3	10.0%
No clench, grind and balance	27	90.0%
Total	30	

Tooth	Subject Frequency	Relative Frequency
2/31	3	100.0%
14/19	1	33.3%
3/30	1	33.3%
15/18	2	66.0%

*Subjects who elicited the symptoms of clenching or grinding and had a balancing side contact.

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TABLE XVII

There were no subjects which elicited the symptoms of clenching or grinding associated with pain of the temporomandibular joint.

TABLE XVIII

There were no subjects which elicited the symptoms of clenching or grinding associated with noise of the temporomandibular joint.

APPROVAL SHEET

The thesis submitted by Gerald A. Tarsitano, D.D.S., has been read and approved by the following Committee:

William F. Malone, D.D.S., M.S., Ph.D.

Douglas C. Bowman, B.S., M.S., Ph.D.

Robert Thomas, D.D.S., M.S.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given final approval by the Committee with reference to content and form.

The thesis is therefore accepted in partial fulfillment of the requirements for the degree of Master of Science.

5/14/76
Date

William F. Malone
Director's Signature